

O P E R A T I O N S
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What is claimed is:

1. A cabled conductor comprising a plurality of transposed strands each comprising one or more filaments comprising grains of textured anisotropic superconducting compounds which have crystallographic grain alignment that is substantially unidirectional and directionally independent of the rotational orientation of the strands and filaments in the cabled conductor.
1. 2. A cabled conductor comprising a plurality of strands transposed about the longitudinal axis of the conductor, each strand comprising one or more filaments comprising grains of an anisotropic superconducting compound textured such that the crystallographic c axis alignment of each grain of the superconducting compound is substantially perpendicular to the longitudinal axis of the cabled conductor, independent of the rotational orientation of the strands and filaments in the cabled conductor.
1. 3. A cabled conductor according to claim 2 wherein each strand further comprises a conductive matrix material surrounding or supporting the filaments.
1. 4. A cabled conductor according to claim 2 wherein the anisotropic superconducting compound is a superconducting ceramic.
1. 5. A cabled conductor according to claim 4 wherein the superconducting ceramic material comprises a superconducting oxide.
1. 6. A cabled conductor according to claim 2 wherein each strand is insulated.
1. 7. A cabled conductor according to claim 2 wherein each filament is twisted.
1. 8. A cabled conductor according to claim 7 wherein each strand has a preselected strand lay pitch and each filament has a preselected filament cross-section and filament twist pitch, and the strand lay pitch, filament cross-section and filament twist pitch being cooperatively selected to provide a filament transposition area which is always at least ten times the preferred direction area of a typical grain of the desired anisotropic superconducting compound.
1. 9. A cabled conductor according to claim 8 wherein the strand lay pitch, filament cross-section and filament twist pitch are cooperatively selected to provide a filament transposition area which is always at least thirty times the preferred direction area of a typical grain of the desired anisotropic superconducting compound.
1. 10. A cabled conductor according to claim 5 wherein the superconducting ceramic is micaceous or semi-micaceous.
1. 11. A cabled conductor according to claim 10 wherein the superconducting ceramic is a member of the bismuth family of superconducting oxides.
1. 12. A cabled conductor according to claim 11 wherein the filaments are twisted and the filament cross-section, filament twist pitch, and strand lay pitch are cooperatively selected so that at each point on the filament, regardless of how it is twisted, the filament width in the plane of the widest longitudinal cross-section of the conductor is always greater than, and preferably twice as large as the filament height orthogonal to the widest longitudinal cross-section of the conductor.
1. 13. A cabled conductor according to claim 11 wherein the superconducting ceramic is BSCCO 2212.
1. 14. A cabled conductor according to claim 11 wherein the superconducting ceramic is BSCCO 2223.

- 1 15. A cabled conductor according to claim 10 wherein the superconducting ceramic is a
2 member of the thallium family of superconducting oxides.
- 1 16. A cabled conductor according to claim 5 wherein the superconducting ceramic is a
2 member of the rare earth family of superconducting oxides.
- 1 17. A cabled conductor according to claim 16 wherein the cabled conductor is a Litz
2 cable.
- 1 18. A cabled conductor according to claim 17 wherein the cable is a Rutherford cable.
- 1 19. A cabled conductor according to claim 17 wherein the cable is a Roebel cable.
- 1 20. A cabled conductor according to claim 17 wherein the cable is a braided cable.
- 1 21. A cabled conductor according to claim 16 wherein the strands are only partly
2 transposed.
- 1 22. A method for manufacturing a superconducting cabled conductor comprising the
2 steps of:
3 forming a plurality of composite strands, each strand comprising at least one
4 filament having a preselected filament cross-section and containing grains of a desired
5 anisotropic superconducting compound or its precursors;
6 forming a cabled intermediate from the strands by transposing them about the
7 longitudinal axis of the conductor at a preselected strand lay pitch, and, texturing the
8 strands in one or more steps including at least one step involving application of a
9 texturing process with a primary component directed orthogonal to the widest
10 longitudinal cross-section of the cabled intermediate, and if a precursor to the desired
11 superconducting compound remains, at least one thermomechanical processing step at
12 conditions sufficient to produce phase transformation in the filament material, at least one
13 such orthogonal texturing step occurring subsequent to said strand transposition step;
14 thereby forming a superconducting cabled conductor having a crystallographic grain
15 alignment substantially independent of the rotational orientation of the strands and
16 filaments in the cabled conductor.
- 1 23. A method for manufacturing a superconducting cabled conductor according to claim
2 22 wherein each strand further comprises a conductive matrix material surrounding or
3 supporting the filaments.
- 1 24. A method for manufacturing a superconducting cabled conductor according to claim
2 22 wherein the anisotropic superconducting compound is a superconducting ceramic.
- 1 25. A method for manufacturing a superconducting cabled conductor according to claim
2 24 wherein the superconducting ceramic material comprises a superconducting oxide.
- 1 26. A method for manufacturing a superconducting cabled conductor according to claim
2 22 wherein the filaments are twisted to a predetermined twist pitch.
- 1 27. A method for manufacturing a superconducting cabled conductor according to claim
2 26 wherein the strand lay pitch, filament cross-section and filament twist pitch are
3 cooperatively selected to provide a filament transposition area which is always at least
4 ten times the preferred direction area of a typical grain of the desired anisotropic
5 superconducting compound.
- 1 28. A method for manufacturing a superconducting cabled conductor according to claim
2 27 wherein the strand lay pitch, filament cross-section and filament twist pitch are
3 cooperatively selected to provide a filament transposition area which is always at least
4 thirty times the preferred direction area of a typical grain of the desired anisotropic
5 superconducting compound.

1 29. A method for manufacturing a superconducting cabled conductor according to claim
2 23 including the further step of insulating the strands.

1 30. A method for manufacturing a superconducting cabled conductor according to claim
2 25 wherein the superconducting ceramic is micaceous or semi-micaceous.

1 31. A method for manufacturing a superconducting cabled conductor according to claim
2 22 wherein the orthogonal texturing step includes non-axisymmetric deformation
3 texturing with a primary component of the force tensor directed orthogonal to the widest
4 longitudinal cross-section of the cabled intermediate.

1 32. A method for manufacturing a superconducting cabled conductor according to claim
2 31 wherein the superconducting ceramic is a member of the bismuth family of oxide
3 superconductors.

1 33. A method for manufacturing a superconducting cabled conductor according to claim
2 31 wherein the superconducting ceramic is a member of the thallium family of oxide
3 superconductors.

1 34. A method for manufacturing a superconducting cabled conductor according to claim
2 25 wherein the superconducting ceramic is a member of the rare earth family of oxide
3 superconductors.

1 35. A method for manufacturing a superconducting cabled conductor according to claim
2 22 wherein the orthogonal texturing step includes a magnetic alignment step with a
3 primary aligning force orthogonal to the widest longitudinal cross-section of the cabled
4 intermediate.

1 36. A method for manufacturing a superconducting cabled conductor according to claim
2 22 wherein the orthogonal texturing step includes a melt-texturing step with the primary
3 temperature gradient orthogonal to the widest longitudinal cross-section of the cabled
4 intermediate.

1 37. A method for manufacturing a superconducting cabled conductor according to claim
2 22 wherein the desired superconducting compound requires biaxial texture and the
3 texturing step includes application of a texturing process with a second primary
4 component in a predetermined direction in the plane of the widest longitudinal cross-
5 section of the cabled conductor.

1 38. A method for manufacturing a superconducting cabled conductor comprising the
2 steps of:

3 first, forming a plurality of composite strands, each strand comprising at least one
4 twisted filament having a preselected filament cross-section and twist pitch, surrounded
5 or supported by a matrix material and containing grains of the precursors to a desired
6 member of the bismuth family of superconducting oxides;

7 second, forming a cabled intermediate from the strands by transposing them about
8 the longitudinal axis of the conductor at a preselected strand lay pitch, the strand lay
9 pitch, filament cross-section and filament twist pitch being cooperatively selected to
10 provide a filament transposition area which is always at least thirty times the preferred
11 direction area of a typical grain of the desired superconducting oxide;

12 and, texturing the strands in one or more steps including at least one orthogonal
13 texturing step which includes non-axisymmetric deformation texturing with a primary
14 component of the force tensor directed orthogonal to the widest longitudinal cross-section
15 of the cabled intermediate, and at least one thermomechanical processing step at
16 conditions sufficient to produce phase transformation in the filament material, at least one

- 17 such orthogonal texturing step occurring subsequent to said strand transposition step;
18 thereby forming a superconducting cabled conductor having a crystallographic grain
19 alignment substantially independent of the rotational orientation of the strands and
20 filaments in the cabled conductor.
- 1 39. A method according to claim 38 further including one or more heat treatment steps at
2 conditions chosen to provide crack healing in the filament material but not to melt the
3 matrix material.
- 1 40. A method for manufacturing a superconducting cabled conductor according to claim
2 38 wherein the filaments are twisted and the filament cross-section, filament twist pitch,
3 and strand lay pitch are cooperatively selected so that at each point on the filament,
4 regardless of how it is twisted, the filament width in the plane of the widest longitudinal
5 cross-section of the conductor is always greater than, and preferably twice as large as the
6 filament height orthogonal to the widest longitudinal cross-section of the conductor.
- 1 41. A method for manufacturing a superconducting cabled conductor according to claim
2 38 wherein the orthogonal texturing step further comprises a magnetic alignment step.
- 1 42. A method for manufacturing a superconducting cabled conductor according to claim
2 38 wherein the superconducting ceramic is BSCCO 2212.
- 1 43. A method for manufacturing a superconducting cabled conductor according to claim
2 38 wherein the superconducting ceramic is BSCCO 2223.